APPENDIX I

PRELIMINARY RISK ASSESSMENT

Technical Memorandum

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To: Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor, Fort McClellan, Calhoun County, Alabama
Preliminary Risk Assessment File

Date: February 8, 2002

Subject: **PRELIMINARY RISK ASSESSMENT FOR SUBJECT SITE**

This memorandum provides a Preliminary Risk Assessment (PRA) for the Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, located in the southeastern Choccolocco Corridor, herein referred to as Parcels 237Q-X and 238Q-X. The PRA approach is a shortened version of the Streamlined Risk Assessment (SRA) protocol developed as a uniform and economical approach to evaluating hundreds of similar sites at Fort McClellan (FTMC). It is assumed that the reader is familiar with FTMC and the fundamentals of the SRA protocol. The reader is referred to the Installation-Wide Work Plan (IT, 2002a) for more detail. All the comparison and computational operations of the PRA are performed within EXCEL® spread sheet tables. The results of each step are described below. The PRA was performed in two iterations – a first iteration and a refined assessment – depending on where refinement was required in the selection of site-related chemicals, as explained below.

Media of Interest and Data Selection. Media of interest are surface soil, subsurface soil, groundwater, surface water, and sediment. Data consist of 10 surface soil and 3 depositional soil samples (collectively evaluated as surface soil), 10 subsurface soil samples, 3 groundwater samples, 2 surface water samples, and 2 sediment samples. All samples were analyzed for metals and nitroaromatic explosives. The validated data for the chemicals detected are summarized in the Site Investigation (SI) Report (IT, 2002b).

Site-Related Chemical Selection. Site-related chemicals are those presumed to be released by the army during operation of FTMC. Site-related chemicals were selected for the first iteration

of the risk assessment by comparing the maximum detected concentration (MDC) of each chemical with its background screening criterion (BSC), computed as two times the mean of the background data set, consistent with EPA (2002) Region IV guidance. Chemicals whose MDCs exceed their BSCs were selected as site-related chemicals and were subjected to COPC selection (described below) for inclusion in the first iteration of the risk assessment. The site-related chemicals chosen in this manner are identified in Tables 1, 2, and 3 (surface soil), Tables 4, 5, and 6 (subsurface soil), Tables 7 and 8 (groundwater), Table 9 (surface water), and Table 10 (sediment). BSCs were taken from tables of the SI Report (IT, 2002b).

Upper tolerance limits (UTL), the highest metal concentrations reasonably considered to be within background, are also included in Tables 1 through 10 for information, but were not used to select site-related chemicals for the first iteration of risk estimates. The UTL provides a more refined statistical approach than the BSC for comparing site and background data, and were used where needed for the second iteration to refine the risk estimates. UTLs were developed for the entire FTMC facility, combining data from the Main Post and Pelham Range.

Chemical of Potential Concern Selection. Chemicals of potential concern (COPC) are site-related chemicals whose MDCs exceed their site-specific screening levels (SSSL), and which may contribute significantly to risk. The SSSLs are receptor-, medium-, and chemical-specific risk-based concentrations that capture all the exposure assumptions and toxicity assessment of a full-blown baseline risk assessment. COPCs were selected for both cancer risk and noncancer effects when the data permitted (Tables 1 through 10).

Receptor Scenario Selection. The proposed site reuse plan states that the site will be used by the State Forestry Commission. The most plausible receptors are a groundskeeper, which represents the upper-bound on exposure for occupational site use, and the recreational site user, which is consistent with site use by the State Forestry Commission. Both receptor scenarios were evaluated herein. An on-site resident was also included as the upper-bound evaluation of exposure and risk for any land-use scenario, and to provide additional perspective. SSSLs for all three receptor scenarios were used to select COPCs for surface and subsurface soil. The groundskeeper and the resident, but not the recreational site user, are assumed to be exposed to groundwater developed as a source of potable water. The assumptions for residential and recreational site user exposure to surface water and sediment are identical, and it is assumed that

the groundskeeper is not regularly exposed to surface water and sediment. Therefore, only recreational site user SSSLs were used for COPC selection for surface water and sediment.

Risk Characterization. Risk characterization combines the exposure assumptions and toxicity assessment (incorporated in the SSSLs) with the exposure-point concentration (EPC) to quantify the incremental lifetime cancer risk (ILCR) and noncancer hazard index (HI). ILCR and HI estimates are computed for each chemical in each medium, and are summed across media to yield a total ILCR and total HI for each receptor scenario. The PRA differs from an SRA in that ordinarily no attempt is made to estimate an EPC that reflects a conservative estimate of average concentration for use in risk assessment. The 95 percent upper confidence limit on the mean (UCL) is usually used for this purpose. Instead, the MDC is adopted as the EPC, which imparts a conservative bias to the PRA.

EPA (1990) considers ILCR estimates below 1E-6 to be negligible, ILCR estimates from 1E-6 to 1E-4 to fall within a risk management range, and ILCR estimates above 1E-4 to be generally unacceptable. Risk values are rounded to one significant figure to reflect the uncertainty about their estimation (EPA, 1989, 2002). For example, a calculated ILCR of 9.50E-7 would be rounded to 1E-6 and interpreted as falling within the risk management range. Similarly, a calculated ILCR of 1.49E-4 would be rounded to 1E-4 and interpreted as falling within, but not exceeding, the risk management range. Also, an HI of 1.49E+0 would be rounded to 1 and interpreted as not exceeding the threshold level of 1. Risk estimates in this document are presented in scientific notation with two places to the right of the decimal to facilitate checking of calculations. Rounding is done only if needed to simplify interpretation.

The groundskeeper is potentially exposed to soil and groundwater at Parcel 237Q-X and 238Q-X. COPCs selected from exposure to surface soil for the first iteration of the risk assessment included aluminum, arsenic, chromium, iron, and manganese (Table 1). The total ILCR for surface soil was 3.46E-5, which is within the acceptable range. The total HI for surface soil of 4.33E+0 exceeds the threshold value of 1. The MDCs for aluminum, chromium, and manganese fall below their respective UTLs and within the range of background (data not shown) (SAIC, 1998). It was judged that the presence of these metals reflects background conditions, and these metals were dropped from the refined assessment. The MDCs for arsenic (2.65E+1 mg/kg) and iron (6.96E+4 mg/kg) exceed the UTLs (2.54E+1 mg/kg and 5.54E+4 mg/kg respectively), but

are within the range of background. To be conservative, arsenic was retained as a site-related COPC in the refined assessment.

Iron was also considered to be a site-related COPC; however, due to problems regarding the oral reference dose (RfD), iron was not selected as a COPC for the refined assessment. The appropriateness of the oral RfD for iron is controversial, especially for exposure to iron in soil. The oral RfD reflects estimates of iron intakes based on nutritional surveys, but identifies neither a no-observed-adverse-effect level nor lowest-observed-adverse-effect level for iron ingestion. As such, it is likely that a much higher level of dietary iron intake would be innocuous, although this possibility was not evaluated in the oral RfD documentation. In addition, it is likely that the forms of iron present in the plant and animal products that comprise the diets evaluated in the nutritional survey are more bioavailable than those present in soil or other environmental media.

Also, there are only two documented scenarios of toxicity to humans from iron ingestion. One involves acute ingestion of large quantities of iron in nutritional supplements formulated to enhance bioavailability for efficacy against iron-deficiency anemia. The other is the occurrence of hemosiderosis in Bantu consuming Kaffir beer. It has been established, however, that the iron in the beer is present in a soluble form that is as bioavailable as the iron in nutritional supplements. Presumably, high bioavailability is important in development of toxicity to ingested iron. Iron in soil is subject to binding to other minerals (matrix effect), and the presence of other minerals would reduce the extent to which iron ingested in soil is absorbed. For these reasons, EPA (2002) declines to use the RfD available for iron to calculate an HI for iron.

Surface soil COPCs for the groundskeeper for the refined assessment were limited to arsenic, based on cancer risk. The ILCR was 1.67E-5, which is within the risk management range.

COPCs selected for the groundskeeper for exposure to subsurface soil for the first iteration included aluminum, arsenic, chromium, cobalt, iron, and manganese (Table 4). The total ILCR for subsurface soil was 3.29E-5, which is within the acceptable range. The total HI for subsurface soil of 4.14E+0 exceeds the threshold value of 1. The MDCs for arsenic, cobalt, and manganese fall below their respective UTLs and within the range of background (data not shown) (SAIC, 1998). It was judged that the presence of these metals reflects background conditions, and these metals were dropped from the refined assessment. The MDCs for aluminum (1.68E+4 mg/kg) and chromium (5.45E+1 mg/kg) slightly exceed their UTLs

(1.66E+4 and 5.34E+1 respectively) but are within the range of background. To be conservative, aluminum and chromium were retained as site-related COPCs in the refined assessment. The MDC for iron (8.86E+4 mg/kg) exceeds the UTL (4.35E+4 mg/kg) and the range of background. Iron was considered to be a site-related COPC, but was not assessed further as explained above for the surface soil evaluation. Subsurface soil COPCs for the groundskeeper for the refined assessment were limited to chromium, based on cancer risk, and aluminum, based on noncancer effects. The refined assessment yielded an ILCR of 1.60E-5, which is within the risk management range, and an HI of 2.51E-1, which is below the threshold level of 1.

2,6-Dinitrotoluene was selected as the only COPC for groundskeeper exposure to groundwater (Table 7). The total ILCR of 2.28E-6 for exposure to groundwater is within the risk management range. Because no noncancer COPCs were selected, no HI was calculated. No refinement in selecting COPCs was attempted because 2,6-dinitrotoluene is clearly a site-related chemical.

The groundskeeper was evaluated for exposure to surface soil, subsurface soil, and groundwater. The ILCR values and HI values from the refined assessment were summed across media to account for simultaneous exposure to multiple media. The total ILCR of 3.5E-5 for groundskeeper exposure to all media falls within the risk management range. The total HI of 2.51E-1 is below the threshold of 1. It is concluded that exposure to surface soil, subsurface soil, and groundwater poses no unacceptable cancer risk or adverse noncancer health effects to the groundskeeper.

No chemicals were selected as COPCs for recreational site user exposure to surface soil (Table 2), subsurface soil (Table 5), surface water (Table 9), or sediment (Table 10); therefore, neither an ILCR nor an HI were estimated for this receptor. It is concluded that recreational site user exposure to surface soil, subsurface soil, surface water and sediment at Parcels 237Q-X and 238Q-X is unlikely to result in unacceptable cancer risk or adverse noncancer health effects.

The on-site resident was also evaluated as the upper-bound on exposure and risk, and to provide additional perspective. The on-site resident is potentially exposed to soil, groundwater, surface soil and sediment. COPCs selected for residential exposure to surface soil for the first iteration included aluminum, arsenic, chromium, iron, manganese, and vanadium (Table 3). Arsenic was the only COPC evaluated for cancer risk; arsenic and the other COPCs were evaluated for noncancer effects. The total ILCR for surface soil was 6.22E-5, which is within the risk

management range. The total HI for surface soil was 5.45E+0, which exceeds the threshold value of 1. The MDCs for aluminum, chromium, manganese, and vanadium fall below their respective UTLs and are within the range of background (data not shown) (SAIC, 1998). It was judged that the presence of these metals reflects background conditions, and these metals were dropped from the refined assessment. The MDC for arsenic is just slightly higher than the UTL, and within the range of background. To be conservative arsenic was retained as a site-related COPC for the refined assessment. Although the MDC for iron is greater than the UTL and exceeds the range of background, it was dropped from the refined assessment for the reasons explained above. The total HI of 1.13E+0 calculated for exposure to surface soil in the refined assessment is attributed to arsenic only. When rounded to one significant figure, the HI does not exceed the threshold value of 1.

COPCs selected for the first iteration for residential exposure to subsurface soil included aluminum, arsenic, chromium, iron, manganese, thallium, and vanadium (Table 6). Arsenic was evaluated for cancer risk; all COPCs including arsenic were evaluated for noncancer hazard. The ILCR for subsurface soil of 6.29E-5 is within the risk management range. The HI for subsurface soil of 6.59E+0 exceeds the threshold value of 1. The MDCs for arsenic, manganese, and thallium, fall below their respective UTLs and within the range of background (data not shown) (SAIC, 1998). It was judged that the presence of these metals reflects background conditions, and they were dropped from the refined assessment. Although iron was considered to be a site-related COPC, it was dropped from the refined assessment for the reasons discussed above. The MDCs for aluminum and chromium exceed their respective UTLs but fall within the range of background. The MDC for vanadium exceeds the UTL and the range of background. To be conservative, aluminum, chromium and vanadium were included as site-related COPCs for the refined assessment. The total HI for subsurface soil was 6.46E-1, which is below the HI threshold value of 1.

2,6-Dinitrotoluene was selected as the only COPC for residential exposure to groundwater (Table 8). The total ILCR of 9.69E-6 for exposure to groundwater is within the risk management range. Because no noncancer COPCs were selected, no HI was calculated. No refinement in selecting COPCs was attempted because 2,6-dinitrotoluene is clearly a site-related chemical.

The resident theoretically could be exposed to surface soil, subsurface soil, groundwater, surface water, and sediment. As noted above, residential exposure to surface water and sediment would

be identical to that of the recreational site user. COPCs were not selected in surface water or sediment for the recreational site user; therefore, these media were not considered further in the residential evaluation. The ILCR values and HI values from the refined assessment were summed across media to account for simultaneous exposure to multiple media. The total ILCR of 7.19E-5 falls within the risk management range. The total HI of 1.78E+0 exceeds the threshold of 1. However, none of the individual COPCs have an HI greater than 1 when rounded to one significant figure. Furthermore, the HI values should not be added because the COPCs do not share a common target organ (please see toxicity profiles appended to IT [2000]). It was concluded that exposure to surface soil, subsurface soil, groundwater, surface water and sediment poses no unacceptable risk for the resident.

References

IT Corporation (IT), 2002a, ***Installation-Wide Work Plan***, Revision 2, Draft, Fort McClellan, Calhoun County, Alabama, Prepared for U.S. Army Corps of Engineers, Mobile District, February.

IT Corporation (IT), 2002b, ***Site Investigation Report, Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor,*** Fort McClellan, Calhoun County, Alabama, April

Science Applications International Corporation (SAIC), 1998, ***Final Background Metals Survey Report***, prepared for U.S. Army Corps of Engineers, Mobile District, July.

U.S. Environmental Protection Agency (EPA), 1989, ***Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)***, Interim Final, Office of Emergency and Remedial Response, Washington, DC, EPA/540/1-89/002, December.

U.S. Environmental Protection Agency (EPA), 1990, "National Oil and Hazardous Substances Pollution Contingency Plan," ***Federal Register*** 55(46): 8666-8865.

U.S. Environmental Protection Agency (EPA), 2002, ***Region 4 Human Health Risk Assessment Bulletins – Supplement to RAGS, Interim Human Health Risk Assessment Bulletins***, Waste Management Division, EPA Region 4, Atlanta, GA, on line.

Table 1

Preliminary Risk Evaluation for the Groundskeeper Exposure to Surface Soil
Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Groundskeeper Soil SSSL-c[b]	Groundskeeper Soil SSSL-n[c]	Groundskeeper Cancer COPC?[d]	Groundskeeper Noncancer COPC?[e]	Groundskeeper ILCR[f]	Groundskeeper HI[g]
METALS										
Aluminum	1.84E+04	1.63E+04	2.14E+04	1.84E+04	NA	6.69E+03		1.84E+04		2.75E-01
Antimony	1.60E+00	1.99E+00	2.64E+00		NA	4.07E+01				
Arsenic	2.65E+01	1.37E+01	2.54E+01	2.65E+01	1.59E+00	3.06E+01	2.65E+01		1.67E-05	
Barium	1.23E+02	1.24E+02	1.94E+02		NA	6.50E+02				
Beryllium	1.30E+00	8.00E-01	8.68E-01	1.30E+00	1.70E+01	2.39E+01				
Cadmium	1.60E-01	2.90E-01	2.09E-01		2.27E+01	6.55E+01				
Calcium	2.07E+03	1.72E+03	3.54E+03	2.07E+03	NA	NA				
Chromium[h]	6.10E+01	3.70E+01	6.44E+01	6.10E+01	3.41E+00	9.96E+01	6.10E+01		1.79E-05	
Cobalt	2.58E+01	1.52E+01	3.25E+01	2.58E+01	NA	2.90E+01				
Copper	5.60E+01	1.27E+01	2.25E+01	5.60E+01	NA	4.08E+03				
Iron	6.96E+04	3.42E+04	5.54E+04	6.96E+04	NA	3.06E+04		6.96E+04		2.27E-01
Lead	6.49E+01	4.01E+01	6.38E+01	6.49E+01	NA	8.80E+02				
Magnesium	7.02E+03	1.03E+03	9.60E+03	7.02E+03	NA	NA				
Manganese	2.70E+03	1.58E+03	4.66E+03	2.70E+03	NA	7.05E+01		2.70E+03		3.83E+00
Mercury	1.50E-01	8.00E-02	3.22E-01	1.50E-01	NA	2.85E+01				
Nickel	2.69E+01	1.03E+01	2.00E+01	2.69E+01	1.70E+02	2.02E+03				
Potassium	6.10E+03	8.00E+02	6.01E+03	6.10E+03	NA	NA				
Silver	9.24E-01	3.60E-01	1.13E+00	9.24E-01	NA	5.11E+02				
Sodium	3.19E+01	6.34E+02	5.63E+02		NA	NA				
Thallium	1.80E+00	3.43E+00	4.53E-01		NA	6.64E+00				
Vanadium	5.95E+01	5.88E+01	9.94E+01	5.95E+01	NA	6.97E+02				
Zinc	9.20E+01	4.06E+01	7.37E+01	9.20E+01	NA	3.06E+04				
Total ILCR, HI									**3.46E-05**	**4.33E+00**

All concentrations expressed as mg/kg.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
NA = Not Available
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for the groundskeeper exposure to soil.
[c] Site-specific screening level based on noncancer hazard for the groundskeeper exposure to soil.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for the groundskeeper exposed to chemical in surface soil.
[g] Hazard index for noncancer effects for the groundskeeper exposed to chemical in surface soil.
[h] SSSL based on chromium VI.

Table 2

Preliminary Risk Evaluation for Recreational Site User Exposure to Surface Soil
Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Recreational Site-User Soil SSSL-c[b]	Recreational Site-User Soil SSSL-n[c]	Recreational Site-User Cancer COPC?[d]	Recreational Site-User Noncancer COPC?[e]	Recreational Site-User ILCR[f]	Recreational Site-User HI[g]
METALS										
Aluminum	1.84E+04	1.63E+04	2.14E+04	1.84E+04	NA	6.27E+05				
Antimony	1.60E+00	1.99E+00	2.64E+00		NA	2.47E+02				
Arsenic	2.65E+01	1.37E+01	2.54E+01	2.65E+01	2.94E+01	1.89E+02				
Barium	1.23E+02	1.24E+02	1.94E+02		NA	4.41E+04				
Beryllium	1.30E+00	8.00E-01	8.68E-01	1.30E+00	NA	4.08E+02				
Cadmium	1.60E-01	2.90E-01	2.09E-01		NA	3.43E+02				
Calcium	2.07E+03	1.72E+03	3.54E+03	2.07E+03	NA	NA				
Chromium[h]	6.10E+01	3.70E+01	6.44E+01	6.10E+01	NA	1.82E+03				
Cobalt	2.58E+01	1.52E+01	3.25E+01	2.58E+01	NA	3.75E+04				
Copper	5.60E+01	1.27E+01	2.25E+01	5.60E+01	NA	2.52E+04				
Iron	6.96E+04	3.42E+04	5.54E+04	6.96E+04	NA	1.89E+05				
Lead	6.49E+01	4.01E+01	6.38E+01	6.49E+01	NA	4.00E+02				
Magnesium	7.02E+03	1.03E+03	9.60E+03	7.02E+03	NA	NA				
Manganese	2.70E+03	1.58E+03	4.66E+03	2.70E+03	NA	2.85E+04				
Mercury	1.50E-01	8.00E-02	3.22E-01	1.50E-01	NA	1.84E+02				
Nickel	2.69E+01	1.03E+01	2.00E+01	2.69E+01	NA	1.20E+04				
Potassium	6.10E+03	8.00E+02	6.01E+03	6.10E+03	NA	NA				
Silver	9.24E-01	3.60E-01	1.13E+00	9.24E-01	NA	3.16E+03				
Sodium	3.19E+01	6.34E+02	5.63E+02		NA	NA				
Thallium	1.80E+00	3.43E+00	4.53E-01		NA	4.10E+01				
Vanadium	5.95E+01	5.88E+01	9.94E+01	5.95E+01	NA	4.00E+03				
Zinc	9.20E+01	4.06E+01	7.37E+01	9.20E+01	NA	1.88E+05				
Total ILCR, HI									--	--

All concentrations expressed as mg/kg.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
-- = No ILCR or HI calculated
NA = Not Available
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for recreational site user exposure to soil.
[c] Site-specific screening level based on noncancer hazard for recreational site user exposure to soil.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for recreational site user exposed to chemical in surface soil.
[g] Hazard index for noncancer effects for recreational site user exposed to chemical in surface soil.
[h] SSSL based on chromium VI.

Table 3

Preliminary Risk Evaluation for the Resident Exposure to Surface Soil
Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Resident SS SSSL-c[b]	Resident SS SSSL-n[c]	Resident Cancer COPC?[d]	Resident Noncancer COPC?[e]	Resident ILCR[f]	Resident HI[g]
METALS										
Aluminum	1.84E+04	1.63E+04	2.14E+04	1.84E+04	NA	7.80E+03		1.84E+04		2.36E-01
Antimony	1.60E+00	1.99E+00	2.64E+00		NA	3.11E+00				
Arsenic	2.65E+01	1.37E+01	2.54E+01	2.65E+01	4.26E-01	2.34E+00	2.65E+01	2.65E+01	6.22E-05	1.13E+00
Barium	1.23E+02	1.24E+02	1.94E+02		NA	5.47E+02				
Beryllium	1.30E+00	8.00E-01	8.68E-01	1.30E+00	NA	9.60E+00				
Cadmium	1.60E-01	2.90E-01	2.09E-01		NA	6.25E+00				
Calcium	2.07E+03	1.72E+03	3.54E+03	2.07E+03	NA	NA				
Chromium[h]	6.10E+01	3.70E+01	6.44E+01	6.10E+01	NA	2.32E+01		6.10E+01		2.63E-01
Cobalt	2.58E+01	1.52E+01	3.25E+01	2.58E+01	NA	4.68E+02				
Copper	5.60E+01	1.27E+01	2.25E+01	5.60E+01	NA	3.13E+02				
Iron	6.96E+04	3.42E+04	5.54E+04	6.96E+04	NA	2.34E+03		6.96E+04		2.97E+00
Lead	6.49E+01	4.01E+01	6.38E+01	6.49E+01	NA	4.00E+02				
Magnesium	7.02E+03	1.03E+03	9.60E+03	7.02E+03	NA	NA				
Manganese	2.70E+03	1.58E+03	4.66E+03	2.70E+03	NA	3.63E+02		2.70E+03		7.44E-01
Mercury	1.50E-01	8.00E-02	3.22E-01	1.50E-01	NA	2.33E+00				
Nickel	2.69E+01	1.03E+01	2.00E+01	2.69E+01	NA	1.54E+02				
Potassium	6.10E+03	8.00E+02	6.01E+03	6.10E+03	NA	NA				
Silver	9.24E-01	3.60E-01	1.13E+00	9.24E-01	NA	3.91E+01				
Sodium	3.19E+01	6.34E+02	5.63E+02		NA	NA				
Thallium	1.80E+00	3.43E+00	4.53E-01		NA	5.08E-01				
Vanadium	5.95E+01	5.88E+01	9.94E+01	5.95E+01	NA	5.31E+01		5.95E+01		1.12E-01
Zinc	9.20E+01	4.06E+01	7.37E+01	9.20E+01	NA	2.34E+03				
Total ILCR, HI									**6.22E-05**	**5.45E+00**

All concentrations expressed as mg/kg.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
NA = Not Available
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for resident exposure to surface soil.
[c] Site-specific screening level based on noncancer hazard for resident exposure to surface soil.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for resident exposed to chemical in surface soil.
[g] Hazard index for noncancer effects for resident exposed to chemical in surface soil.
[h] SSSL based on chromium VI.

Table 4

Preliminary Risk Evaluation for the Groundskeeper Exposure to Subsurface Soil
Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Groundskeeper Soil SSSL-c[b]	Groundskeeper Soil SSSL-n[c]	Groundskeeper Cancer COPC?[d]	Groundskeeper Noncancer COPC?[e]	Groundskeeper ILCR[f]	Groundskeeper HI[g]
METALS										
Aluminum	1.68E+04	1.36E+04	1.66E+04	1.68E+04	NA	6.69E+03		1.68E+04		2.51E-01
Antimony	2.70E+00	1.31E+00	3.84E+00	2.70E+00	NA	4.07E+01				
Arsenic	2.68E+01	1.83E+01	5.49E+01	2.68E+01	1.59E+00	3.06E+01	2.68E+01		1.69E-05	
Barium	1.49E+02	2.34E+02	4.50E+03		NA	6.50E+02				
Beryllium	3.50E+00	8.60E-01	2.19E+00	3.50E+00	1.70E+01	2.39E+01				
Cadmium	4.30E-01	2.20E-01	6.20E-01	4.30E-01	2.27E+01	6.55E+01				
Calcium	1.15E+03	6.37E+02	1.45E+03	1.15E+03	NA	NA				
Chromium[h]	5.45E+01	3.83E+01	5.34E+01	5.45E+01	3.41E+00	9.96E+01	5.45E+01		1.60E-05	
Cobalt	5.33E+01	1.75E+01	5.47E+01	5.33E+01	NA	2.90E+01		5.33E+01		1.84E-01
Copper	9.63E+01	1.94E+01	3.42E+01	9.63E+01	NA	4.08E+03				
Iron	8.86E+04	4.48E+04	4.35E+04	8.86E+04	NA	3.06E+04		8.86E+04		2.89E-01
Lead	2.08E+02	3.85E+01	5.00E+02	2.08E+02	NA	8.80E+02				
Magnesium	6.62E+03	7.66E+02	5.94E+03	6.62E+03	NA	NA				
Manganese	2.41E+03	1.36E+03	3.79E+03	2.41E+03	NA	7.05E+01		2.41E+03		3.42E+00
Mercury	2.70E-01	7.00E-02	1.09E-01	2.70E-01	NA	2.85E+01				
Nickel	4.26E+01	1.29E+01	2.78E+01	4.26E+01	1.70E+02	2.02E+03				
Potassium	5.98E+03	7.11E+02	1.42E+03	5.98E+03	NA	NA				
Thallium	1.80E+00	1.40E+00	2.35E+01	1.80E+00	NA	6.64E+00				
Vanadium	1.04E+02	6.49E+01	9.17E+01	1.04E+02	NA	6.97E+02				
Zinc	1.41E+02	3.49E+01	8.50E+01	1.41E+02	NA	3.06E+04				
Total ILCR, HI									**3.29E-05**	**4.14E+00**

All concentrations expressed as mg/kg.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
NA = Not Available
-- = No ILCR or HI calculated
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for the groundskeeper exposure to soil.
[c] Site-specific screening level based on noncancer hazard for the groundskeeper exposure to soil.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for recreational site user exposed to chemical in subsurface soil.
[g] Hazard index for noncancer effects for recreational site user exposed to chemical in subsurface soil.
[h] SSSL based on chromium VI.

Table 5

Preliminary Risk Evaluation for Recreational Site User Exposure to Subsurface Soil
Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Recreational Site-User Soil SSSL-c[b]	Recreational Site-User Soil SSSL-n[c]	Recreational Site-User Cancer COPC?[d]	Recreational Site-User Noncancer COPC?[e]	Recreational Site-User ILCR[f]	Recreational Site-User HI[g]
METALS										
Aluminum	1.68E+04	1.36E+04	1.66E+04	1.68E+04	NA	6.27E+05				
Antimony	2.70E+00	1.31E+00	3.84E+00	2.70E+00	NA	2.47E+02				
Arsenic	2.68E+01	1.83E+01	5.49E+01	2.68E+01	2.94E+01	1.89E+02				
Barium	1.49E+02	2.34E+02	4.50E+03		NA	4.41E+04				
Beryllium	3.50E+00	8.60E-01	2.19E+00	3.50E+00	NA	4.08E+02				
Cadmium	4.30E-01	2.20E-01	6.20E-01	4.30E-01	NA	3.43E+02				
Calcium	1.15E+03	6.37E+02	1.45E+03	1.15E+03	NA	NA				
Chromium[h]	5.45E+01	3.83E+01	5.34E+01	5.45E+01	NA	1.82E+03				
Cobalt	5.33E+01	1.75E+01	5.47E+01	5.33E+01	NA	3.75E+04				
Copper	9.63E+01	1.94E+01	3.42E+01	9.63E+01	NA	2.52E+04				
Iron	8.86E+04	4.48E+04	4.35E+04	8.86E+04	NA	1.89E+05				
Lead	2.08E+02	3.85E+01	5.00E+02	2.08E+02	NA	4.00E+02				
Magnesium	6.62E+03	7.66E+02	5.94E+03	6.62E+03	NA	NA				
Manganese	2.41E+03	1.36E+03	3.79E+03	2.41E+03	NA	2.85E+04				
Mercury	2.70E-01	7.00E-02	1.09E-01	2.70E-01	NA	1.84E+02				
Nickel	4.26E+01	1.29E+01	2.78E+01	4.26E+01	NA	1.20E+04				
Potassium	5.98E+03	7.11E+02	1.42E+03	5.98E+03	NA	NA				
Thallium	1.80E+00	1.40E+00	2.35E+01	1.80E+00	NA	4.10E+01				
Vanadium	1.04E+02	6.49E+01	9.17E+01	1.04E+02	NA	4.00E+03				
Zinc	1.41E+02	3.49E+01	8.50E+01	1.41E+02	NA	1.88E+05				
Total ILCR, HI									--	--

All concentrations expressed as mg/kg.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
NA = Not Available
-- = No ILCR or HI calculated
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for recreational site user exposure to soil.
[c] Site-specific screening level based on noncancer hazard for recreational site user exposure to soil.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for recreational site user exposed to chemical in subsurface soil.
[g] Hazard index for noncancer effects for recreational site user exposed to chemical in subsurface soil.
[h] SSSL based on chromium VI.

Table 6

Preliminary Risk Evaluation for the Resident Exposure to Subsurface Soil
Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Resident Soil SSSL-c[b]	Resident Soil SSSL-n[c]	Resident Cancer COPC?[d]	Resident Noncancer COPC?[e]	Resident ILCR[f]	Resident HI[g]
METALS										
Aluminum	1.68E+04	1.36E+04	1.66E+04	1.68E+04	NA	7.80E+03		1.68E+04		2.15E-01
Antimony	2.70E+00	1.31E+00	3.84E+00	2.70E+00	NA	3.11E+00				
Arsenic	2.68E+01	1.83E+01	5.49E+01	2.68E+01	4.26E-01	2.34E+00	2.68E+01	2.68E+01	6.29E-05	1.14E+00
Barium	1.49E+02	2.34E+02	4.50E+03		NA	5.47E+02				
Beryllium	3.50E+00	8.60E-01	2.19E+00	3.50E+00	NA	9.60E+00				
Cadmium	4.30E-01	2.20E-01	6.20E-01	4.30E-01	NA	6.25E+00				
Calcium	1.15E+03	6.37E+02	1.45E+03	1.15E+03	NA	NA				
Chromium[h]	5.45E+01	3.83E+01	5.34E+01	5.45E+01	NA	2.32E+01		5.45E+01		2.35E-01
Cobalt	5.33E+01	1.75E+01	5.47E+01	5.33E+01	NA	4.68E+02				
Copper	9.63E+01	1.94E+01	3.42E+01	9.63E+01	NA	3.13E+02				
Iron	8.86E+04	4.48E+04	4.35E+04	8.86E+04	NA	2.34E+03		8.86E+04		3.78E+00
Lead	2.08E+02	3.85E+01	5.00E+02	2.08E+02	NA	4.00E+02				
Magnesium	6.62E+03	7.66E+02	5.94E+03	6.62E+03	NA	NA				
Manganese	2.41E+03	1.36E+03	3.79E+03	2.41E+03	NA	3.63E+02		2.41E+03		6.64E-01
Mercury	2.70E-01	7.00E-02	1.09E-01	2.70E-01	NA	2.33E+00				
Nickel	4.26E+01	1.29E+01	2.78E+01	4.26E+01	NA	1.54E+02				
Potassium	5.98E+03	7.11E+02	1.42E+03	5.98E+03	NA	NA				
Thallium	1.80E+00	1.40E+00	2.35E+01	1.80E+00	NA	5.08E-01		1.80E+00		3.54E-01
Vanadium	1.04E+02	6.49E+01	9.17E+01	1.04E+02	NA	5.31E+01		1.04E+02		1.96E-01
Zinc	1.41E+02	3.49E+01	8.50E+01	1.41E+02	NA	2.34E+03				
Total ILCR, HI									**6.29E-05**	**6.59E+00**

All concentrations expressed as mg/kg.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
NA = Not Available
-- = No ILCR or HI calculated
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for resident exposure to soil.
[c] Site-specific screening level based on noncancer hazard for resident exposure to soil.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for resident exposed to chemical in subsurface soil.
[g] Hazard index for noncancer effects for resident exposed to chemical in subsurface soil.
[h] SSSL based on chromium VI.

Table 7

Preliminary Risk Evaluation for the Groundskeeper Exposure to Groundwater
Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Groundskeeper GW SSSL-c[b]	Groundskeeper GW SSSL-n[c]	Groundskeeper Cancer COPC?[d]	Groundskeeper Noncancer COPC?[e]	Groundskeeper ILCR[f]	Groundskeeper HI[g]
METALS										
Aluminum	6.19E-01	2.34E+00	9.60E+00		NA	1.01E+01				
Barium	5.21E-02	1.27E-01	4.72E-01		NA	7.12E-01				
Calcium	3.42E+01	5.65E+01	4.52E+02		NA	NA				
Iron	3.83E-01	7.04E+00	2.58E+01		NA	3.05E+00				
Magnesium	2.47E+01	2.13E+01	1.49E+02	2.47E+01	NA	NA				
Manganese	2.70E-01	5.81E-01	4.13E+00		NA	4.44E-01				
Potassium	5.27E+00	7.20E+00	6.85E+01		NA	NA				
Selenium	4.84E-03			4.84E-03	NA	5.08E-02				
Sodium	2.09E+01	1.48E+01	4.90E+01	2.09E+01	NA	NA				
Zinc	6.22E-03	2.20E-01	1.52E+00		NA	3.04E+00				
EXPLOSIVES										
1,3,5-Trinitrobenzene	9.60E-04			9.60E-04	NA	3.05E-01				
2,6-Dinitrotoluene	9.50E-04			9.50E-04	4.17E-04	1.01E-02	9.50E-04		2.28E-06	
2-Nitrotoluene	1.60E-03			1.60E-03	NA	9.69E-02				
3-Nitrotoluene	1.20E-03			1.20E-03	NA	9.63E-02				
Tetryl	1.40E-03			1.40E-03	NA	1.02E-01				
p-Nitrotoluene	5.20E-04			5.20E-04	NA	9.63E-02				
Total ILCR, HI									**2.28E-06**	**NA**

All concentrations expressed as mg/L.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
-- = No ILCR or HI calculated
NA = Not Available
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for groundskeeper exposure to groundwater.
[c] Site-specific screening level based on noncancer hazard for groundskeeper exposure to groundwater.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for groundskeeper exposed to chemical in groundwater.
[g] Hazard index for noncancer effects for groundskeeper exposed to chemical in groundwater.

Table 8

Preliminary Risk Evaluation for the Resident Exposure to Groundwater
Possible Range, Parcel 237Q-X and Impact Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Resident GW SSSL-c[b]	Resident GW SSSL-n[c]	Resident Cancer COPC?[d]	Resident Noncancer COPC?[e]	Resident ILCR[f]	Resident HI[g]
METALS										
Aluminum	6.19E-01	2.34E+00	9.60E+00		NA	1.56E+00				
Barium	5.21E-02	1.27E-01	4.72E-01		NA	1.10E-01				
Calcium	3.42E+01	5.65E+01	4.52E+02		NA	NA				
Iron	3.83E-01	7.04E+00	2.58E+01		NA	4.69E-01				
Magnesium	2.47E+01	2.13E+01	1.49E+02	2.47E+01	NA	NA				
Manganese	2.70E-01	5.81E-01	4.13E+00		NA	7.35E-02				
Potassium	5.27E+00	7.20E+00	6.85E+01		NA	NA				
Selenium	4.84E-03			4.84E-03	NA	7.82E-03				
Sodium	2.09E+01	1.48E+01	4.90E+01	2.09E+01	NA	NA				
Zinc	6.22E-03	2.20E-01	1.52E+00		NA	4.69E-01				
EXPLOSIVES										
1,3,5-Trinitrobenzene	9.60E-04			9.60E-04	NA	4.69E-02				
2,6-Dinitrotoluene	9.50E-04			9.50E-04	9.81E-05	1.56E-03	9.50E-04		9.69E-06	
2-Nitrotoluene	1.60E-03			1.60E-03	NA	1.53E-02				
3-Nitrotoluene	1.20E-03			1.20E-03	NA	1.53E-02				
Tetryl	1.40E-03			1.40E-03	NA	1.56E-02				
p-Nitrotoluene	5.20E-04			5.20E-04	NA	1.53E-02				
Total ILCR, HI									**9.69E-06**	**NA**

All concentrations expressed as mg/L.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
-- = No ILCR or HI calculated
NA = Not Available
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for resident exposure to groundwater.
[c] Site-specific screening level based on noncancer hazard for resident exposure to groundwater.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for resident exposed to chemical in groundwater.
[g] Hazard index for noncancer effects for resident exposed to chemical in groundwater.

Table 9

Preliminary Risk Evaluation for Recreational Site User Exposure to Surface Water
Possible Range, Parcel 237Q-X and Impacet Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Recreational Site-User SW SSSL-c[b]	Recreational Site-User SW SSSL-n[c]	Recreational Site-User Cancer COPC?[d]	Recreational Site-User Noncancer COPC?[e]	Recreational Site-User ILCR[f]	Recreational Site-User HI[g]
METALS										
Aluminum	8.89E-02	5.26E+00	1.70E+01		NA	1.53E+01				
Barium	5.19E-02	7.54E-02	1.13E-01		NA	1.10E+00				
Calcium	4.80E+01	2.52E+01	6.41E+01	4.80E+01	NA	NA				
Iron	1.54E-01	1.96E+01	4.12E+01		NA	4.70E+00				
Magnesium	2.45E+01	1.10E+01	2.44E+01	2.45E+01	NA	NA				
Manganese	8.58E-02	5.65E-01	1.83E+00		NA	6.40E-01				
Potassium	2.14E+00	2.56E+00	4.25E+00		NA	NA				
Sodium	1.86E+00	3.44E+00	1.52E+01		NA	NA				
Total ILCR, HI									--	--

All concentrations expressed as mg/L.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
-- = No ILCR or HI calculated
NA = Not Available
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for recreational site user exposure to surface water.
[c] Site-specific screening level based on noncancer hazard for recreational site user exposure to surface water.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for recreational site user exposed to chemical in surface water.
[g] Hazard index for noncancer effects for recreational site user exposed to chemical in surface water.

Table 10

Preliminary Risk Evaluation for Recreational Site-User Exposure to Sediment
Possible Range, Parcel 237Q-X and Impace Area, Parcel 238Q-X, Choccolocco Corridor
Fort McClellan, Calhoun County, Alabama

Chemical	MDC	BSC	UTL	Site-Related Chemical?[a]	Recreational Site-User Sed SSSL-c[b]	Recreational Site-User Sed SSSL-n[c]	Recreational Site-User Cancer COPC?[d]	Recreational Site-User Noncancer COPC?[e]	Recreational Site-User ILCR[f]	Recreational Site-User HI[g]
METALS										
Aluminum	8.57E+03	8.59E+03	1.43E+04		NA	1.15E+06				
Arsenic	1.25E+01	1.13E+01	2.01E+01	1.25E+01	5.58E+01	3.59E+02				
Barium	5.35E+01	9.89E+01	1.91E+02		NA	8.36E+04				
Beryllium	1.05E+00	9.70E-01	1.24E+00	1.05E+00	NA	1.50E+02				
Calcium	7.64E+02	1.11E+03	2.81E+03		NA	NA				
Chromium	2.83E+01	3.12E+01	6.33E+01		NA	2.79E+03				
Cobalt	2.15E+01	1.10E+01	2.19E+01	2.15E+01	NA	6.72E+04				
Copper	9.99E+00	1.71E+01	3.68E+01		NA	4.74E+04				
Iron	2.81E+04	3.53E+04	5.19E+04		NA	3.59E+05				
Lead	3.08E+01	3.78E+01	7.64E+01		NA	4.00E+02				
Magnesium	1.47E+03	9.06E+02	2.20E+03	1.47E+03	NA	NA				
Manganese	1.19E+03	7.12E+02	2.05E+03	1.19E+03	NA	4.38E+04				
Nickel	6.52E+00	1.30E+01	3.16E+01		NA	1.76E+04				
Potassium	1.33E+03	1.01E+03	2.79E+03	1.33E+03	NA	NA				
Silver	7.06E-01	3.20E-01	1.05E+00	7.06E-01	NA	6.07E+03				
Vanadium	1.46E+01	4.09E+01	6.67E+01		NA	4.83E+03				
Zinc	1.93E+01	5.27E+01	1.11E+02		NA	3.44E+05				
Total ILCR, HI									--	--

All concentrations expressed as mg/kg.
MDC = maximum detected concentration; BSC = background screening criterion; UTL = 95% Upper Tolerance Limit.
-- = No ILCR or HI calculated
NA = Not Available
[a] MDC presented only if it exceeds BSC, or no BSC is available.
[b] Site-specific screening level (SSSL) based on cancer risk for recreational site user exposure to sediment.
[c] Site-specific screening level based on noncancer hazard for recreational site user exposure to sediment.
[d] MDC presented only if it exceeds SSSL-c.
[e] MDC presented only if it exceeds SSSL-n.
[f] Incremental lifetime cancer risk for recreational site user exposed to chemical in sediment.
[g] Hazard index for noncancer effects for recreational site user exposed to chemical in sediment.
[h] SSSL based on chromium VI.